gravel extraction permits. Coordinate the design and implementation of gravel pit isolation and stream channel configuration with the Corps, local water management agencies, and local governments.

PROGRAMMATIC ACTION 2C: Develop a cooperative program with the counties, local agencies, and aggregate (sand and gravel) resource industry to develop and implement gravel management programs for each of the three rivers.

PROGRAMMATIC ACTION 2D: Develop a cooperative program to implement a salmonid spawning and rearing habitat restoration program, including reconstructing channels at selected sites by isolating or filling in inchannel gravel extraction areas.

RATIONALE: *Stream meander, natural sediment supply, and floodplain and flood processes are closely linked and some of the programmatic actions under stream corridor would also be appropriate for natural sediment supply or floodplain processes. Between 1942 and 1993, approximately 6.8 to 13.6 million tons of bed material were mined from the active Merced River channel. The pits that resulted from this excavation occupy approximately 4 miles of the existing river channel between the towns of Cressey and Snelling (Kondolf et al. 1996). Restoration planning for the lower Tuolumne River has identified the need for channel reconstruction in approximately 8.5 total miles, or 42%, of the spawning reach (from RM 45.3 to RM 25.1), isolation of backwater areas at approximately 20 sites located from RM 50.3 to RM 30.1, and isolation of gravel pits from the active channel at approximately 10 locations from RM 50.0 to RM 30.5. Gravel mining was less extensive on the lower Stanislaus River, but channel improvements there are also needed.*

Stream channel restoration to isolate or reduce gravel extraction pits has been identified as an important component of a comprehensive spawning and rearing habitat improvement program in the basin (California Department of Fish and Game 1993, U.S. Fish and Wildlife Service 1995).

Additional research or technical advice is required to understand better and develop specific projects designed to improve stream channel meander, improve sediment supplies, and to increase the benefits of the interaction of streams with their floodplains.

NATURAL FLOODPLAIN AND FLOOD PROCESSES

TARGET 1: Restore and improve opportunities for rivers to inundate (flood) their floodplain on a seasonal basis (◆).

PROGRAMMATIC ACTION 1A: Conduct a feasibility study to construct setback levees in the Stanislaus, Tuolumne, and Merced River floodplains.

PROGRAMMATIC ACTION 1B: Restore, as needed, stream channel and overflow basin configurations within the floodplain.

PROGRAMMATIC ACTION 1C: Minimize effects of permanent structures, such as bridges and diversion dams, on floodplain processes.

PROGRAMMATIC ACTION 1D: Develop a floodplain management plan for the Stanislaus River.

PROGRAMMATIC ACTION 1E: Develop a floodplain management plan for the Tuolumne River.

PROGRAMMATIC ACTION 1F: Develop a floodplain management plan for the Merced River.

RATIONALE: *Setback levees will provide greater floodplain inundation, room for stream meander, and greater amounts of riparian forest and seasonal wetland habitats along the lower rivers. Channel configuration adjustments may be necessary to accelerate restoration of natural floodplain habitats and to restore and maintain configurations that may not occur naturally due to remaining constraints from new setback levees. Permanent structures, such as bridges and diversions dams can interrupt and impair natural floodplain processes and habitat development and succession, thus requiring removal of the structures, rebuilding, or some continuing maintenance or mitigative efforts to minimize their effects.*

The present channel capacity of the Tuolumne river is about 9,000 cfs which is not large enough to meet the needs of maintaining a healthy alluvial river ecosystem. The January 1997 flood on the lower Tuolumne River peaked at 60,000 cfs and provided a glimpse of the resiliency of the Tuolumne River. While the high flows damaged development in the floodplain, it also created alternate bars in the channel, recruited gravel from the banks as the river meandered, and placed large woody debris in the

stream channel. As a result of the 1997 floods, the Governor's Flood Emergency Action Team Final Report (May 10, 1997) recommended that the U.S. Army Corps of Engineers conduct a study to increase the channel capacity in the Tuolumne river to convey flows up to 20,000 cfs. This would more than double the present 9,000 cfs capacity, mimic the seasonal peak to a greater degree, and provide additional ecological benefits while providing greater flexibility to manage floods. An expanded floodway on the Tuolumne river would also address the implementation objectives related to natural sediment supply, stream meander, and stream temperatures.

Other benefits of improving the quantity of floodplains include:

- *increased shading and food web support,*
- *re-establishment of stream meander, and*
- *potential conversion of agricultural land to floodplain and the reduced need for diversion.*

CENTRAL VALLEY STREAM TEMPERATURES

TARGET 1: Maintain maximum surface water temperatures on the lower Merced, Tuolumne, and Stanislaus rivers to the downstream boundary of the salmon spawning area (as defined by Fish and Game Code section 1505) during summer, fall and winter and to the mouth of the river during the spring as follows (◆◆◆):

- October 15 through February 15, 56°F, and
- April 1 through May 31, 65°F.

PROGRAMMATIC ACTION 1A: Cooperatively evaluate the use of temperature control devices/reservoir management options to reduce water temperatures during critical periods.

PROGRAMMATIC ACTION 1B: Evaluate the impact of irrigation returns on stream temperature.

PROGRAMMATIC ACTION 1C: Cooperatively develop temperature models for all three tributaries to determine flows necessary to maintain 60°F in the designated salmon spawning areas from June 1 through September 30 to provide the necessary conditions for steelhead rearing.

RATIONALE: *Water temperatures in the lower rivers in fall and spring often exceed stressful or lethal levels for fall-run chinook salmon. High temperatures typically occur in drought periods, when storage levels in reservoirs have dropped sufficiently to allow warm surface waters to be included in storage releases to the lower river. Retaining water over the summer that may otherwise be released for downstream irrigation or other purpose may allow the cold water in the reservoirs to be retained through the early fall critical temperature period. Elevated temperatures are thought to delay migration and spawning (California Department of Fish and Game 1992), reduce egg survival, and increase mortality of rearing and outmigrating juveniles (California Department of Fish and Game 1993). The target temperature levels would maintain suitable habitat for chinook salmon for spawning, rearing, and outmigration throughout the lower rivers. These levels are identified in DFG (1993) and in USFWS (1995). Temperature models need to be developed and calibrated to determine the feasibility of providing the flows necessary to maintain 60° F in the designated salmon spawning areas from June 1 through September 30 to provide the necessary conditions for steelhead rearing.*

High water temperature below dams in summer is a critical stressor for steelhead throughout the Central Valley drainages (IEP Steelhead Project Workteam 1999). Because juvenile steelhead must rear for at least one year in fresh water, adequate temperatures must be maintained year-round. Providing the necessary cool temperatures in the reaches that contain rearing habitat will be necessary to achieve steelhead recovery in these streams.

HABITAT

GENERAL HABITAT RATIONALE

The primary focus of habitat restoration in the East San Joaquin Ecological Management Zone is directed at restoring riparian and riverine aquatic habitats. Many other habitats are important in providing for the diversity of fish, wildlife and plant species in this zone including seasonal wetlands, fresh emergent wetlands, and agricultural lands. Important areas that will provide these types of habitats include Merced National Wildlife Refuge and San Joaquin River National Wildlife Refuge which overlaps the East San Joaquin and San Joaquin River Ecological Management Zones. In addition, the Central Valley Habitat Joint Venture is implementing recommendations to improve seasonal wetlands and

agricultural lands through out the San Joaquin River and East San Joaquin Ecological Management Zones.

Expansion of the San Joaquin River NWR will be an important component in providing the habitats required by waterfowl, shorebirds, and other neotropical migrant species. Congress has approved the 10,300 acre San Joaquin River NWR. Presently, the San Joaquin NWR encompasses about 800 acres of land along the east side of the San Joaquin River near the confluence of the Tuolumne River, and is working to acquire an additional 6,200 acres of fish and wildlife habitat on land adjacent to the existing refuge. Part of this expansion has recently been funded through the CALFED Category III habitat restoration program. This project will benefit Aleutian Canada geese, greater sandhill crane, western yellow-billed cuckoo, Swainson's hawk, riparian brush rabbit, riparian wood rat, valley elderberry longhorn beetle, splittail, waterfowl, shorebirds, herons, and neotropical migratory birds.

The Central Valley Habitat Joint Ventures goals for the San Joaquin Valley, including the East San Joaquin Ecological Management Zone, are to:

- *Protect 52,500 acres of existing wetland in perpetuity through fee acquisition or conservation easements,*
- *Restore and protect in perpetuity 20,000 acres of former wetlands,*
- *Enhance 120,300 acres of existing wetlands, and*
- *Enhance 15,290 acres of private agricultural lands to support nesting and wintering waterfowl.*

Some of these habitat improvement and restoration projects will occur in the East San Joaquin Ecological Management Zone.

RIPARIAN AND RIVERINE AQUATIC HABITAT

TARGET 1: Provide conditions for riparian vegetation growth along sections of rivers in the East San Joaquin Basin Ecological Management Zone (◆◆).

PROGRAMMATIC ACTION 1A: Purchase streambank conservation easements from willing sellers, or establish voluntary incentive programs to improve salmonid habitat and instream cover along the Stanislaus River.

PROGRAMMATIC ACTION 1B: Evaluate the benefits of restoring aquatic and riparian habitats on the Stanislaus River, including creating side channels to serve as spawning and rearing habitats for salmonids.

PROGRAMMATIC ACTION 1C: Purchase streambank conservation easements from willing sellers, or establish voluntary incentive programs to improve salmonid habitat and instream cover along the Tuolumne River.

PROGRAMMATIC ACTION 1D: Purchase streambank conservation easements from willing sellers, or establish voluntary incentive programs to improve salmonid habitat and instream cover along the Merced River.

RATIONALE: *Many wildlife species, including several species listed as threatened or endangered under the State and federal Endangered Species Acts (ESA) and several special-status plant species in the Central Valley, depend on or are closely associated with riparian habitats. Riparian habitats support a greater diversity of wildlife species than all other habitat types in California. Degradation and loss of riparian habitat have substantially reduced the habitat area available for associated wildlife species. Loss of this habitat has reduced water storage, nutrient cycling, and foodweb support functions.*

Improving low- to moderate-quality SRA habitat will benefit juvenile chinook salmon and steelhead by improving shade, cover, and food. Other wildlife in this Ecological Management Zone will also benefit from improved habitat. Protecting and improving SRA habitat may involve land use changes that will require the consensus of local landowners and local, State, and federal agencies. Limitations on land suitable or available for restoration will require establishing priorities, with efforts directed at acquiring high-priority, low-cost sites first.

Riparian habitat along the lower portions of the three rivers has been significantly reduced. Before the loss of habitats, riparian forests were an important component of the mosaic (mixture) of habitats in the San Joaquin Valley, providing habitat for many native wildlife species. The riparian community provides nutrient and woody debris input to the

aquatic system, as well as shade and increased bank stability. To restore the riparian community along the lower rivers, further riparian vegetation removal should be restricted, improved land management and livestock grazing practices should be implemented, and a riparian restoration program should be developed and implemented. Restoration actions will need to be consistent with flood control requirements. The importance of riparian restoration was identified by DFG (1993) and USFWS (1995).

FRESHWATER FISH HABITAT AND ESSENTIAL FISH HABITAT

TARGET 1: Maintain and improve existing freshwater fish habitat and essential fish habitat through the integration of actions described for ecological processes, habitats, and stressor reduction or elimination (◆◆).

PROGRAMMATIC ACTIONS: No additional programmatic actions are recommended.

RATIONALE: *Freshwater fish habitat and essential fish habitat are evaluated in terms of their quality and quantity. Actions described for East San Joaquin Ecological Management Zone ecological processes, stressor reduction, and riparian and riverine aquatic habitat should suffice to maintain and restore freshwater and essential fish habitats. For example, maintaining freshwater and essential fish habitats is governed by actions to maintain streamflow, improve coarse sediment supplies, maintain stream meander, maintain or restore connectivity of the rivers in this ecological management zone and their floodplains, and in maintaining and restoring riparian and riverine aquatic habitats.*

STRESSORS

WATER DIVERSIONS

TARGET 1: Reduce entrainment of fish and other aquatic organisms into diversions to a level that will not impair salmon and steelhead restoration by screening 50% of the water volume diverted in the basin (◆◆◆).

PROGRAMMATIC ACTION 1A: Improve existing diversion screens on the lower Merced River.

PROGRAMMATIC ACTION 1B: Evaluate the feasibility of installing state-of-the-art screens on small pump agricultural diversions along the three streams.

PROGRAMMATIC ACTION 1C: Provide alternative water sources to diverters who legally divert water from spawning and rearing areas of the three streams.

PROGRAMMATIC ACTION 1D: Purchase water rights from willing sellers whose diversions entrain significant numbers of juvenile salmon or steelhead.

RATIONALE: *Five medium-sized gravity riparian diversions are located in the designated salmon spawning reach of the lower Merced River between Crocker-Huffman Dam and the State Route 59 bridge. Water-powered screens and nominal bypass systems were installed on two larger diversions in the mid-1980s. Gabion-type screens without bypass systems remain on the other three diversions. In addition, DFG surveys have identified numerous small pump diversions throughout the basin, none of which are adequately screened to prevent juvenile salmon entrainment. Entrainment losses at these pump diversions are unknown. Screening 50% of the diverted water volume at diversions with greatest risk to juvenile salmon and steelhead, as determined by monitoring, will help to define further screening needs.*

DAMS AND OTHER STRUCTURES

TARGET 1: Eliminate the loss of adult fall-run chinook salmon that stray into the San Joaquin River upstream of the Merced River confluence (◆◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to eliminate blockage of upstream-migrating fall-run chinook salmon and steelhead at temporary irrigation diversion dams erected during the irrigation season.

PROGRAMMATIC ACTION 1B: Continue annual installation of a temporary weir on the San Joaquin River immediately upstream of the confluence with the Merced River to block adult salmon migration.

PROGRAMMATIC ACTION 1C: Evaluate the need to remove temporary diversion dams that block upstream salmon and steelhead passage into spawning grounds of three streams.

TARGET 2: Evaluate the feasibility of restoring steelhead access to historical habitats (◆).

PROGRAMMATIC ACTION 2A: Investigate the feasibility of providing access to historical steelhead spawning and rearing habitat above the dams on at least one of the three tributaries.

RATIONALE: *In recent years, drainage practices in western Merced County have increased agricultural return flows from Salt and Mud Sloughs into the mainstem San Joaquin River. These flows attract significant numbers of adult salmon into the sloughs and, subsequently, into irrigation canals, where no suitable spawning habitat is available (California Department of Fish and Game 1993). In fall 1991, an estimated 31% of the San Joaquin basin run strayed into westside canals. In the late 1980s, DFG established an adult trapping station at Los Banos Wildlife Refuge, where eggs were taken and reared at MRH. In fall 1992, DFG installed a temporary electrical barrier across the mainstem San Joaquin River immediately upstream from the confluence with the Merced River, which was highly effective in blocking fish passage into the westside irrigation canals. Since that time, a temporary weir has been installed at the site annually, which has also been effective in blocking passage.*

Temporary diversion dams are sometimes constructed in the river channel during the irrigation season. Such structures may hinder upstream salmon migration in the fall and early winter.

Because of the magnitude of spawning and rearing habitat loss for steelhead, providing access to historical habitat that is currently inaccessible due to dams will be a key element in their recovery. The feasibility of providing a means to transport adults and juveniles around the large dams needs to be investigated in the San Joaquin River system.

PREDATION AND COMPETITION

TARGET 1: Reduce adverse effects of non-native fish species that have a significant effect on juvenile salmon production in the rivers (◆).

PROGRAMMATIC ACTION 1A: Eliminate gravel pits within or connected to the rivers.

RATIONALE: *Introduced warmwater fish, such as largemouth and smallmouth bass, prey on juvenile salmonids rearing in the lower Merced River. Predation has been identified as a major factor contributing to the poor survival of salmon smolts emigrating from the river. Large pit areas created by inchannel gravel mining are excellent habitat for warmwater fish. Implementing a predator control program has been identified as a salmonid restoration action by USFWS (1995). Habitat improvement actions described above should help to reduce predator populations of largemouth and smallmouth bass. Other species of possible concern include striped bass, American shad, and resident rainbow and brown trout. All potentially occur in the three rivers, and all are known to feed on juvenile salmon and possibly steelhead. If any of these species become a problem, steps will be taken to reduce their effects.*

HARVEST OF FISH AND WILDLIFE

TARGET 1: Develop harvest management strategies that allow the spawning population of wild, naturally produced fish to attain levels that fully use existing and restored habitat; focus harvest on hatchery-produced fish (◆◆◆).

PROGRAMMATIC ACTION 1A: Control illegal harvest through increased enforcement.

PROGRAMMATIC ACTION 1B: Develop harvest management plans with commercial and recreational fishery organizations, resource management agencies, and other stakeholders to meet target.

PROGRAMMATIC ACTION 1C: Reduce the harvest of wild, naturally produced steelhead populations by continuing to mark all hatchery-reared fish and continuing to institute a selective fishery.

PROGRAMMATIC ACTION 1D: Evaluate a marking and selective fishery program for chinook salmon.

RATIONALE: *Restoring and maintaining chinook salmon and steelhead populations, as well as striped bass and white and green sturgeon, to levels that fully take advantage of available habitat may require restrictions on harvest during and even after the recovery period. Stakeholder involvement should help to balance available harvest allocation fairly. Target population levels may preclude existing harvest levels of wild, naturally produced fish. For populations supplemented with hatchery fish, selective fisheries may be necessary to limit the wild fish harvest while hatchery fish are harvested to reduce their potential to disrupt the genetic integrity of wild populations.*

The Fish and Game Commission recently adopted DFG recommendations to establish a selective fishery for hatchery steelhead and to reduce incidental hooking of wild steelhead in the San Joaquin and other Central Valley streams.

ARTIFICIAL PROPAGATION OF FISH

TARGET 1: Minimize the likelihood that hatchery-reared salmon and steelhead could stray into adjacent non-natal rivers and streams to protect naturally produced salmon and steelhead (◆◆◆).

PROGRAMMATIC ACTION 1A: Cooperatively evaluate the benefits of limiting stocking of MRH-reared salmon and steelhead to the Merced River.

TARGET 2: Employ methods to limit straying and loss of genetic integrity of wild and hatchery-supported stocks (◆◆◆).

PROGRAMMATIC ACTION 2A: Rear hatchery salmon and steelhead in hatcheries on natal streams to limit straying.

PROGRAMMATIC ACTION 2B: Limit stocking of salmon and steelhead fry and smolts to natal watersheds to minimize straying that may compromise the genetic integrity of naturally producing populations.

RATIONALE: *In watersheds like the San Joaquin basin, where dams and habitat degradation have limited natural spawning, some hatchery supplementation may be necessary to sustain fishery harvest at former levels and to maintain a wild or natural spawning population during adverse conditions, such as droughts. However, hatchery augmentation should be limited so it does not inhibit recovery and maintenance of wild populations. Hatchery-reared salmon and steelhead might directly compete with and prey on wild salmon and steelhead. Straying of adult hatchery fish into non-natal watersheds might also threaten the genetic integrity of wild stocks. Hatchery fish might also threaten the genetic makeup of stocks in natal rivers. Some general scientific information and theory from other river systems indicate that hatchery supplementation may limit the recovery and long-term maintenance of naturally producing salmon and steelhead populations. Further research and experimentation are necessary to determine how this issue is addressed. Long-term hatchery augmentation of healthy wild stocks may genetically undermine that stock and threaten the genetic integrity of other stocks.*

Adult straying into non-natal streams might result in interbreeding with a wild population specifically adapted to that watershed and thus lead to the loss of genetic integrity in the wild population. Releasing hatchery-reared fish into the San Joaquin River and its tributaries, other than the Merced River, could compromise the genetic integrity of wild salmon and steelhead populations.

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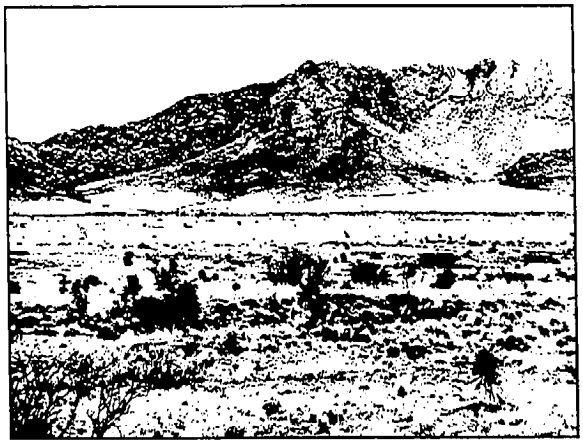
◆ WEST SAN JOAQUIN BASIN ECOLOGICAL MANAGEMENT ZONE



INTRODUCTION

The West San Joaquin Basin Ecological Management Zone includes the eastern slope of the Coast Range and portions of the southwestern Central Valley. The zone is bounded on the north by the southern and western boundaries of the Sacramento-San Joaquin Delta Ecological Management Zone, on the east by the west bank of the San Joaquin River from the Stanislaus River to Mendota Pool, on the south by Panoche Creek, and on the west by the west slope of the Interior Coast Range. The West San Joaquin Basin Ecological Management Zone can indirectly contribute to the health of the Bay-Delta by providing much needed habitat for California red-legged frog, neotropical migrant birds, and waterfowl. Included in this Ecological Management Zone is the area between Orestimba Creek and Los Banos, a region which supports a number of federal and state-listed species, including the San Joaquin kit fox and blunt-nosed leopard lizard. About 33% of the remaining wetland acres in the Central Valley are clustered between Merced and Los Banos along the San Joaquin River. This is the largest contiguous block of remaining wetland habitat and associated upland communities.

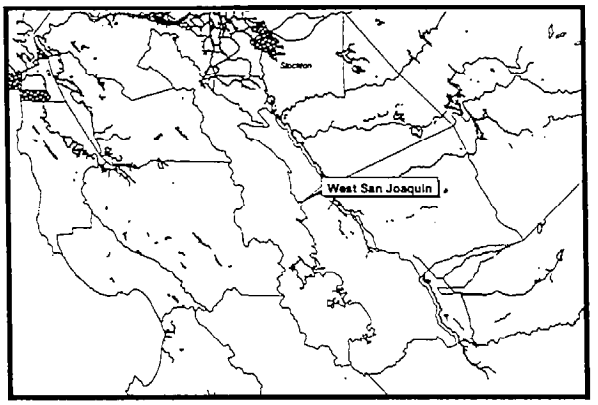
The West San Joaquin Ecological Management Zone also contains several stands of Central California sycamore alluvial woodlands. The largest of these stands is located on Los Banos Creek, in Merced County. The principal environmental conditions necessary for the perpetuation of this community are intermittent flooding over broad floodplains and stable subterranean water table during dry summer months (California Department of Fish and Game 1997).

Although the overall vision for this Ecological Management Zone is directed by its ability to contribute to the ecological health of the Sacramento-San Joaquin Delta, there exist many opportunities to build upon the CALFED vision to provide many additional landscape ecological benefits in the region. For example, CALFED actions could contribute, in part, to a long-term goal of providing a continuous band of connective habitats (riparian, wetland, vernal pool, grassland, and other upland habitats) joining the Sierra (Yosemite National Park) with grassland and vernal pool complexes on the east side of the valley.

DESCRIPTION OF THE MANAGEMENT ZONE

The West San Joaquin Valley Ecological Management Zone has two distinct geomorphological (landform) areas: the hilly west-side arid watersheds and the valley floodplain on the eastern side adjacent to the San Joaquin River. The Delta-Mendota Canal of the Central Valley Project (CVP) and the California Aqueduct of the State Water Project (SWP) are dominant features of the zone from north to south, separating the hills from the valley. All watersheds in this zone flow east toward the San Joaquin River. Restoration efforts associated with the San Joaquin River corridor are addressed in the section on the San Joaquin River.

The zone has a Mediterranean climate. The northwestern portion of the zone is adjacent to the Delta, where the rain shadow effect and fog still have some influence. Within the rest of the zone, summers are hotter and longer winters are colder,



Location Map of the West San Joaquin Ecological Management Zone.

and rainfall averages are lower. The southern and eastern portion of the zone is best described as an agricultural belt with large blocks of seasonally managed wetlands on both public and privately managed lands in the Grasslands Subarea. While some other habitats exist in the Grasslands Subarea, they are extremely narrow, fragmented, and widely scattered. Habitats that do remain include grasslands, seasonal wetlands, and riparian woodlands. The grasslands have been reduced to narrow strips within the rights-of-way along the California Aqueduct and Delta-Mendota Canal; other grasslands persist in scattered cattle ranches. Low quality seasonal wetlands can be found as small clumps of vegetation that persist in drainages and sumps associated with the Aqueduct and Canal. In addition, remnant riparian areas can be found along some drainages and tributaries associated with the Aqueduct and Canal.

The northern and western portions of the zone are best characterized as rolling hills of the coastal mountain range. The upper third is still within the influence of weather patterns associated with the Carquinez Strait. Fog and moisture from the rain shadow effect separates this area from the southern two-thirds of the unit, where the climate is more Mediterranean. While the northern area receives greater rainfall and moisture, the habitats found in the north and south are relatively similar. The dominant type is grassland, managed as cattle pastures. Savannas (grasslands with few trees) are common on the hills as the slopes stretch out of the Valley, while woodlands are prevalent along the creeks and their watersheds. Patches of seasonal wetlands can also be found along some creeks.

The Orestimba Creek and Los Banos Creek drainages are excellent examples of relatively undisturbed, natural, coast range watersheds. While the grasses have become predominately annuals (before European influence, these grasslands were dominated by perennial grass species), they still flourish and lead into wooded areas at the higher elevations and riparian woodlands along the creeks. There are two very significant stands of Sycamore Alluvial Woodlands that compose more than one-third of all remaining acreage of this habitat type within the Central Valley. Most of the landscape is rolling hills of the coastal range, with grasslands in the lower elevations and woodlands higher up. The geomorphology of these watersheds has remained relatively unchanged.


Orestimba Creek showing a sycamore alluvial woodland.

Biological resources in this area include the San Joaquin kit fox, San Joaquin antelope squirrel, kangaroo rats, neotropical migrant birds, California red-legged frog, foothill yellow-legged frog, waterfowl, upland game, western pond turtles, sycamore alluvial woodlands, vernal pools, as well as many other native plants and wildlife found in the several habitat types. Some unique animal and plant communities are found in some equally unique habitats, such as the vernal pool-hog wallow grassland found on the Flying M Ranch in Merced County.

Important ecological processes essential to maintaining and restoring a healthy West San Joaquin Basin Ecological Management Zone are floodplain, stream, and watershed processes, including streamflow, overbank flooding (which is particularly important for maintaining the remnant Central California sycamore alluvial woodlands), floodplain inundation, sedimentation and erosion, and fire. Fire is important for maintaining, or

altering grassland and shrubland health through fuel reduction and plant succession and reproduction.

Streamflow in this arid zone, despite being intermittent and prone to flash flooding, is an essential determinant of habitat, as well as species distribution and abundance. Floodplain and stream channel processes are essential for dissipating the forces of flood flows and distributing sediments carried by them.

Though many of the streams along the west side of the San Joaquin Valley are naturally intermittent, maintaining natural winter and spring flows in the streams is important for maintaining floodplain processes, such as meander belts, and stream channel configurations, as well as riparian and wetland habitats. Streamflows have been modified by water diversions, subsidence (lowering) in groundwater tables, and watershed activities, such as grazing, road building, forest management, and agriculture.

In addition to changes in streamflow, floodplain processes have been altered by floodplain development, including flood control levees, gravel mining, and other land uses.

The West San Joaquin Basin Ecological Management Zone has many habitat types including:

- **AGRICULTURE:** the hills and lowlands of the valley that support crops,
- **WETLANDS:** the lowlands of the valley that are permanently or seasonally watered,
- **COASTAL SCRUB:** a low growing shrubby cover on the coastal hills,
- **CHAPARRAL:** dense shrubs found growing above the coastal scrub community,
- **OAK WOODLAND:** almost park-like sites with trees and shrubs in fairly open stands with a rich carpet of grass and other herbaceous growth,
- **OAK SAVANNA:** the transitional community between the woodlands of the hills and the grasslands of the broad valleys, where the trees are fewer in number and more widely spaced than those of the woodlands,
- **GRASSLAND:** areas that stand below the hillside wooded areas, and are green and littered with wildflowers in the spring followed by the gold of summer as the annual and perennial grasses go dormant during the dry season,
- **RIPARIAN FOREST:** a continuum of plant communities following the topographic line from the stream channel through the low and high terrace deposits of the floodplain; transition to non-riparian is usually abrupt, especially near agriculture;
- **SEASONAL WETLANDS:** areas within the grasslands and along the tributaries and drainages that remain inundated with water for varying periods after the rains and high flows have subsided; and
- **SYCAMORE ALLUVIAL WOODLANDS:** sycamore woodlands found along Los Banos and Orestimba creeks that require high soil moisture during the initial growth annual cycle followed by a significant reduction in the water table during the later part of the growing season.

These habitats are used by a wide variety of fish, wildlife, and plants, including many listed species (i.e., species identified by resource agencies as threatened or endangered). Coastal scrub and chaparral provide habitat for a variety of wildlife. Numerous rodents inhabit chaparral; deer and other herbivores often make extensive use of this habitat type, which provides critical summer range foraging areas, escape cover, and fawning habitat. Many birds, such as quail, fulfill a variety of their habitat needs in the chaparral, such as foraging needs (seeds, fruits, insects), protection from predators and climate, as well as singing, roosting, and nesting sites.

The oak woodland and savanna habitats are home to as many as 29 species of amphibians (salamanders) and reptiles, 79 bird species, and 22 mammal species. Seasonal wetlands provide habitat for many species, such as waterfowl, pond turtles, salamanders, as well as endemic (adapted to a particular locality) plants. Grassland habitat, as well as some of the special habitat features, such as cliffs, caves, and ponds found within grasslands, are used by many species, including tiger salamanders. Some of the more arid grassland species are listed as threatened or endangered. The riparian habitats provide food; water; migration and dispersal